



Analysis of Antioxidants and UV Stabilizers in Polymers using HPLC

Angelika
Gratzfeld-Huesgen

Polymer
/chemical industry

Abstract

Additives are frequently used to protect polymers against thermo-oxidative degradation and destruction caused by UV irradiation. The following antioxidants and UV stabilizers were analyzed using reversed phase liquid chromatography and diode-array detection in technical styrene.

- Uvinol 3000 • Tinuvin P • Irganox 1098 • Uvinol 3008 • Lavinix BHT • Tinuvin 320 • Irganox 1010
- Irganox 1076 • Irgafos 168

Irganox 1010 for example, is a highly effective, non-discoloring stabilizer for organic substrates such as plastics, synthetic fibers, elastomers, waxes, oils and fats. Tinuvin P can be used to protect plastics against UV irradiation as it absorbs the UV light and transfers it into thermal energy which cannot destroy the polymer. Both compound classes have a wide ranging molecular structure and molecular weight. Irganox 1010 has a molecular weight of 1178 and its chemical structure is [3-(3,5-di-tert.butyl-4-hydroxyphenyl)-propionate]. Tinuvin P has a much lower molecular weight of 225 and its chemical structure is 2-(2'-hydroxy-5'-methyl-phenyl)-benzotriazol.

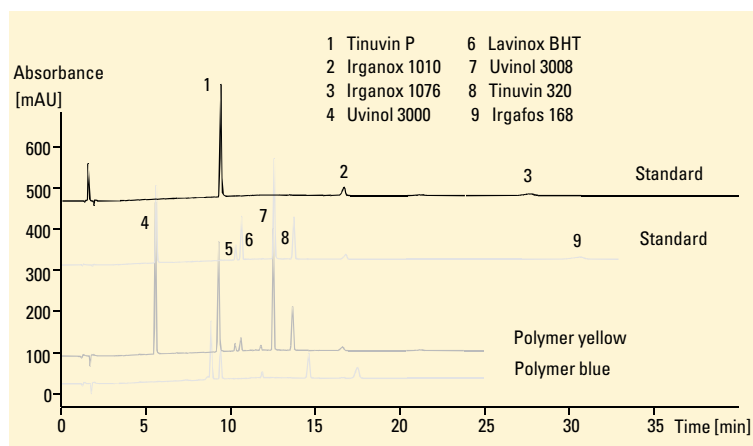


Figure 1
Analysis of antioxidants and stabilizers with the same conditions

Conditions

Column 125 x 3 mm BDS, 3 μ m

Mobile Phase A = Water + 0.001 m Tetrabutylammoniumhydrogensulfate, pH = 3.0 with H₂SO₄, B = Acetonitrile

Gradient

Start with 30 % B, to 98 % B in 10 min

Flow Rate 0.5 ml/min

Injection Vol 5 μ l

Oven Temp 40 $^{\circ}$ C

UV-Detector DAD, 280/20 nm

Reference 900/50 nm

Sample preparation

Polymer samples were dissolved in Tetrahydrofuran and filtered after extraction with ultra-sonic bath for 30 min



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Antioxidants and UV stabilizers are typically added to polymers as a mixture of several compounds, which also includes costabilizers and antistatic agents. The application range of these additives is broad and can be found in most polymers.

All mentioned compounds are soluble in organic solvents and can be analyzed using reversed phase HPLC with ion-pairing modifier. In addition to the identification by retention time, UV spectra were used.

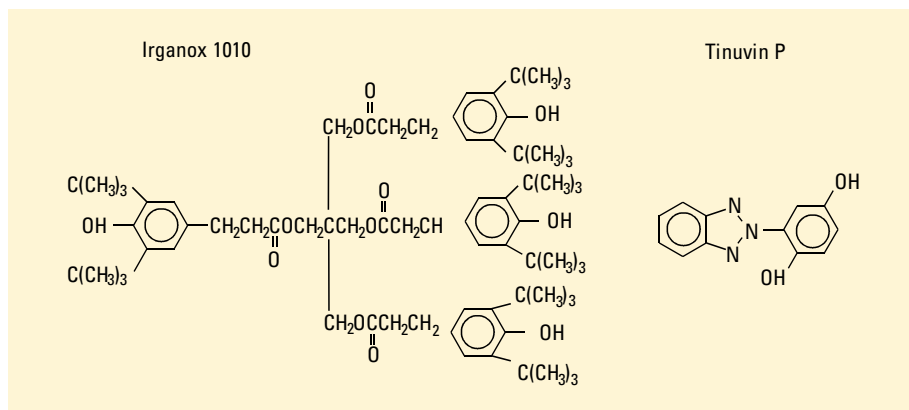


Figure 2
Formula of Antioxidants

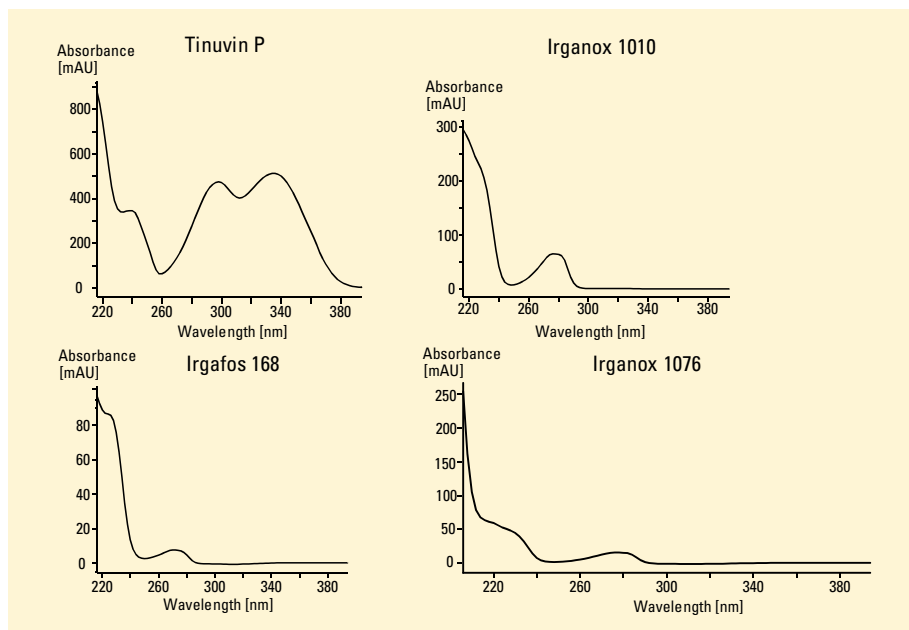


Figure 3
Spectra of antioxidants

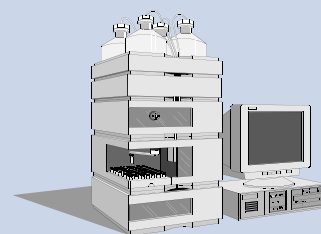
Method performance

Limit of Detection (LOD) = < 1 ng
Precision of retention times (rsd) = 0.2 %
Precision of areas (rsd) = < 3 %

Equipment

Agilent 1100 Series

- degasser
 - binary pump
 - autosampler
 - thermostatted column compartment
 - diode array detector
- Agilent ChemStation + software



Angelika Gratzfeld-Huesgen is application chemist at Agilent Technologies, Waldbronn, Germany.

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